AMERICAN JOURNAL of PHARMACY

SINCE 1825

A Record of the Progress of Pharmacy and the Allied Sciences

Vol. 104 DECEMBER, 1932 No. 12

CONTENTS

Price $3.00 per Annum in Advance **Foreign Postage, 25 Cents Extra**

Single Numbers, 30 Cents. Back Numbers, 50 Cents

Entered as Second-Class Matter at the Post Office at Philadelphia, Pa., Under the Act of March 3, 1879

Acceptance for Mailing at Special Rate of Postage Provided for in Section 1103, Act of October 3, 1917. Authorized February 15, 1920

PUBLISHED MONTHLY BY THE

Philadelphia College of Pharmacy and Science

43d Street and Kingsessing Avenue, West Philadelphia, Pa.

American Journal of Pharmacy

ESTABLISHED IN 1825

Four preliminary numbers were published at different times until in 1829, when the publication of the regular volumes began. Since then the publication has been uninterrupted. During the period from 1829 to 1852 four numbers were published annually, except in 1847, when five numbers were published. From 1853 to 1870 six numbers were published. Since this time twelve numbers have been published annually.

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Covers with Titles					2 pp.	4 pp.	8 pp.	16 pp.
25	copies.....	$1.75	25	copies.....	$2.25	$3.75	$ 7.75	$ 9.00
50	"	2.00	50	"	2.50	4.00	8.25	9.75
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THE AMERICAN
JOURNAL OF PHARMACY

VOL. 104 DECEMBER, 1932 NO. 12

EDITORIALS

THE STATE CONTROL OF MEDICINE

NO ONE with a knowledge of the facts involved and presuming to exercise a fair sense of judgment can fail to admire the American Medical Association for the organized way in which it has achieved to most of its objectives.

The technique of its actual leaders, the so-called permanent medical autocracy, with headquarters at Chicago, has been effective to an unusual degree—and this, in spite of the fact, strangely enough, that the average medical man, even though a member of the Association, hardly ever speaks of the political leaders, responsible for its destinies, with else than disaffection.

Yet, presuming that the leadership has been so far successful, they benignly accept its ministry, with the same degree of indifference and apathy that the mackerel accepts the ocean.

Their leaders have served them well. There has been conserved for them, within their profession, a self-government that has no equal in latitude and freedom in any other trade or profession.

Yet, today, it is an assured fact that medicine is facing a change which, strange enough to precedent, is destined to occur through influences outside the profession itself. And that change is the inevitable result of the holier-than-thou attitude maintained by the aforementioned medical leaders—who in the dumb sublimity of faith in their narrow policies have either incurred the ill will or lost the friendship of agencies which might otherwise have supported them—at least in their *good works*.

One does not have to be abundant in discernment to observe that the present practice of medicine is inadequate to the nation's needs.

Nor does one have to read the voluminous report of the Committee on the Costs of Medical Care to so conclude.

Proof enough is had in the existence of the heterogeneity of medical cults, ministering, for good and for bad, to the untutored demands of a public left medically stranded.

There are more —ics, and —paths, and detours to legitimate medicine than ever existed.

And, many intelligent people—people who have the capacity of being discriminate—find so little satisfaction at the hand of the regular system of medicine—find so little satisfaction being bandied about, among self-appointed specialists, that eventually *sans* tonsils, *sans* teeth, *sans* appendix and *sans* confidence, they seek a healing elsewhere—and oddly enough they often, often find it in the most unlikely places.

Patent medicines flourish as they never flourished before and instead of a regulated sale through pharmaceutical channels they are sold indiscriminately by grocers, cut-rate merchandizers, and department stores—all this, in spite, or because of, the campaign of education fostered by the Chicago headquarters.

These are but isolated proofs of organized medicine's misdirection of fundamentals. While Chicago's solons are busy certifying crackers and cheese—and compiling tonics and sedatives—the really great problems in medicine have been either neglected or mishandled.

And now looms the denouement.

One of the straws that points to the change which is undeniably imminent is the recent majority report of the Committee on the Costs of Medical Care, where the State Control of Medical Practice is offered as the way out of the hectic maze occasioned by the acknowledged failure of modern medicine to function to the best advantage of our social structure.

The minority report, and the American Medical Association are united in a frantic disavowal of the aforementioned majority report—and in view of the past and present policy of that powerful organization one would hardly expect anything else.

After a forceful and patient campaign of education and action the American Medical Association came very close to exterminating that beloved old institution—the family doctor. The smaller medical colleges which had been very successful in turning out doctors who remained close to their people, and who had the desire and capacity to serve—those colleges were throttled. And the new plan of medical

education was so disposed that it aborted an overwhelming horde of would-be specialists, for whom human beings were experimental animals—and who required years of extra-mural disillusion to make them useful in their work of healing.

No wonder that the cults have damagingly flourished. No wonder that the patent medicine is staging a comeback!

But—there are some signs, too, of an awakening at headquarters. For instance, an editorial appearing in a recent issue of the Journal champions the return of "the general practitioner"!!! And what a turn-about-face that is!!!

But, just the same—there is a legible "handwriting on the wall"—and *pro bono publico*—not *pro bono medico*—it will be heeded.

IVOR GRIFFITH.

METHYLENE BLUE PROVES SUCCESSFUL ANTIDOTE TO CYANIDE POISON—Methylene blue has proved a successful antidote in cyanide poisoning. It may also be useful in carbon monoxide poisoning.

A patient was brought into the Park Emergency Hospital, San Francisco, completely unconscious after taking potassium cyanide, a deadly poison. Methylene blue was injected into a vein and fifteen minutes later he had completely recovered. In reporting the case to the American Medical Association, Dr. J. C. Geiger, Director of Public Health for San Francisco, pointed out that the use of the dye was the direct result of a survey of the treatment of poison cases of all kinds as practiced by the Emergency Hospital Service of the Department of Public Health. The survey was made by Dr. P. J. Hanzlik, professor of pharmacology at Stanford University Medical School, and Dr. C. D. Leake, professor of pharmacology at the University of California Medical School.

This survey was requested by Dr. Geiger a few months previously, after the futility of other methods of treatment was shown in three fatal cases of cyanide poisoning. A result of the survey was an outline by Dr. Hanzlik of modern antidotes and appropriate treatment of cases of various types of poisoning. This outline is now in use by the department, with the good results shown in the cyanide poisoning case just reported.

The use of methylene blue and of other dyes was suggested by studies of Dr. Otto Warburg and others, Dr. Geiger said in commenting on the recommendations of Drs. Hanzlik and Leake.—(*Science News Letter*, Dec. 17, 1932.)

ARE THERE TOO MANY GRADUATES?

THE faculties of some of our colleges admit that possibly we are turning out too many graduates in pharmacy.

A trade journal recently stated that in the great army of the unemployed there are thirty thousand drug clerks. Some of them are quite on the bread line.

Our colleges each year are adding to the roll upwards of three thousand graduates in pharmacy.

It is a sort of cold comfort to note that over 60 per cent. of young engineers and a goodly percentage of graduate chemists, architect and other professions are job seekers. This is quite the reverse o a few years ago when large corporations were urgently scanning th lists of graduates from our colleges for bright young men to fil waiting positions.

Just now pharmaceutical manufacturers are looking for other things than new employees.

The graduate in pharmacy is joining the army of seven million people who are unemployed.

The world has changed markedly since these present-day graduates were freshmen.

For our encouragement they tell us that things will become worse before they change for the better.

We hear tales of former depression days when drug clerks fared badly. One chap walked the streets of a metropolis for a month, finally landing a job as night clerk in a prescription store at five dollars per week. It was the beginning of a successful career.

Another got stage fright in his first board examination. He went back to his books, primed up, and at last become a notable figure in pharmacy.

In these days, where can a new-born graduate in pharmacy find a place?

Fortunately, a fair number of these graduates have a place waiting for them which they are well prepared to fill.

The first thing to do is to find a job. Some kind of a job. Any kind of a job.

The graduate should find a place—even to doffing the "high hat" when necessary and muddling around at the bottom. Fifteen dollars a week assured is far better than wearing out shoe leather searching for a fifty-dollar job that is not to be had.

Under present conditions the prize-taking graduate can well afford to become a soda water expert, to get behind the cigar or candy counter, or to drop into any opening offered.

One graduate in pharmacy took a place as delivery clerk and porter, and so pleased the customers by his energy and tact that the good will and prestige of the store was increased and he obtained a raise in salary.

The graduate should keep in touch with his Alma Mater and the faculty. Perhaps he can take a post-graduate course in, say, merchandizing. He may use the college library. He should read the journals. He should keep abreast of the progress of his art and of the world.

One graduate put in a home laboratory. He tried tests and studied new ideas. A practical outcome was a new form of soap which promises to become a moderate success.

Another chap took a position as motor driver for a laundry, with a chance to solicit business for a druggist as a side line. He made progress.

Sometimes there are emergency low-pay openings in the dispensing department of hospitals and physicians' offices.

There is one thing the new graduate should not do in these days. He should not open a new store or buy out an old one. It is reported that fully one-third of the drug stores now in existence are on the rocks financially, with another third well on the way towards the same condition. So, if the idea should come to add a new drug store in his community, the graduate should do anything else but that.

The education and capability of the present-day graduate is sometimes questioned.

The new graduate in pharmacy has his limitations and his faults. He is a modern human being.

Observers have reported that the present-day graduate has acquired a far greater knowledge of his art than was known to the wisest professor a generation ago. The graduate of today is serious-minded, intelligent, scholarly, studious, aggressive and worldly-wise. He carries the elements needed to attain success and it is up to him to find a place where he may apply them.

The graduation rostrum is crowded—perhaps overcrowded. The new graduate must get busy. There is still plenty of room at the top. But the ascent must begin at the foot. The mount must be made round by round.

FRED B. KILMER.

ORIGINAL ARTICLES

THE MODERN ARSENIC HAZARD*

By J. W. Sturmer, Dean of Science

A SWEDISH scientist has recently published an article in which he attempts to picture the general aspects of the earth's surface at that early geologic period when our planet had not as yet cooled sufficiently to make possible the condensation of water. He visualizes stretches of molten rock substance, slowly cooling and slowly hardening; great beds of lava, and huge accumulations of volcanic dust, blown about by the winds. No trees, no vegetation of any kind, no water, and hence no life.

What a weird picture. Yet in this solidifying earth-crust there must have existed the selfsame chemical elements which we find in the minerals of today; carbon, silicon, calcium, magnesium, sodium, potassium, iron, sulphur, phosphorus, arsenic, and probably, most of the others now listed in our modern table of the elements. Thus there were forms of matter which we might now characterize as poisonous to human beings and other forms of matter which we know to be harmless or inert.

And now the rains. For the first time liquid water is brought in contact with the earth's crust, and the selective action of this solvent begins to operate. Soluble compounds are leached out and the water becomes briny; in this solution various chemical reactions occur and precipitates fall. Some loose, insoluble rock particles also are floated by the water, are carried to distant places and are again deposited. Thus through the centuries an accumulation of sediment results, destined to form a new kind of rock, namely, the sedimentary rock of modern geology.

When upheavals in the earth's crust brought about the birth of continents and islands, and dry land appeared, the uppermost rock strata were, naturally, the layers of sedimentary rock—the rock formed in water. The original rock surface had been covered, and with material which includes *no poisonous ingredients.*

Only where the subsequent shrinking of the earth's crust has resulted in huge wrinkles and bulges, with the formation of cracks and

*One of a Series of Popular Science Lectures given at the Philadelphia College of Pharmacy and Science, 1932 Season.

cavities, has molten rock material from subterranean sources approached the surface. This material, long since cooled and solidified, embodies the minerals from which we derive our metals and our mineral poisons.

Thus it appears that as long as man lived a primitive life, he had no occasion to fear mineral poisons. Harmful plants, yes; and knowledge of these he had to acquire by the trial and error method; but mineral poisons bothered him not at all. Benign processes of nature had provided a covering for these dangerous substances. When, however, man outgrew the implements of the stone age, and entered upon the search for those minerals, which, by the arts of Vulcan, he succeeded in converting into metal, he at the same time started the redistribution of mineral poisons, and thus created new poison hazards.

As a case in point let us consider some interesting facts in connection with the element arsenic, most compounds of which rank as dangerous poisons. Why arsenic compounds are so toxic, modern biochemistry has not explained to our satisfaction; that they are, as a fact, destructive of nearly all forms of life, vegetable or animal, has, however, been conclusively established. Plants, bugs, mammals, all are subject to annihilation by compounds of this poison-producing element. Although differences in susceptibility to the poison are made manifest, no living thing seems to be quite immune, and arsenic tolerance has never been scientifically proven.

The death-dealing effect of the compounds of arsenic on human beings was known to the ancients. Probably no other poison has so frequently, and during a period of time so extensive, been employed with homicidal intent. In ancient Greece, and in Rome, and throughout Europe, in the Middle Ages, it demanded its toll of human lives. During the inglorious years of the Dark Ages, and in the centuries which followed, many professional poisoners plied their nefarious trade, for it was then a practice, not uncommon, to arrange for the removal of personal or political enemies by poison—and the poison arsenic. The ignoble deeds that are brought to light when the student of history scans the literature of arsenic are truly appalling.

In the reign of Louis the 14th, King of France, killings by arsenic were so frequent in court circles, and also in Paris generally, that special laws restricting and controlling its sale had to be enacted. A book recently published, and dealing with the unsavory details of this period, bears the unique title, The Age of Arsenic. It was an age

when a Rabelaisian raspberry, directed toward the host at a society dinner, was apt to bring a retort in the form of a sprinkle of death-dealing arsenic in the dessert. The age of arsenic was also the period in which witchcraft—so-called—flourished. That many innocent persons were suspected of practicing witchcraft, were persecuted, and in fact executed because of such suspicions, is true enough. It is, however, also true that as far as there was a basis in fact to the lurid tales about witches, tales concerning persons with the power to cause cattle and other domestic animals to sicken and die, or to bring disease and death to human beings, the facts had to do with the employment of poison, and the poison—arsenic.

Thanks to the efficiency of the chemical analyst, the age of arsenic, insofar as the term refers to the destruction of human life by intentional poisoning, has long since passed. Modern chemistry now provides the means for the infallible detection of this toxic agent, and for the unmistakable demonstration of its presence, even in minute quantities. There is, indeed, no other poison for which science has provided tests quite so delicate and so reliable. As a consequence the poisoners have been driven to the use of other weapons.

Arsenical poisoning is, however, not always intentional. It may be an inadvertence. It could happen, for example, because of contaminations in chemicals used medicinally. But the delicate tests for arsenic, tests which have operated in making this poison unpopular for purposes of homicide, have been instrumental also in assuring us arsenic-free medicines. Years ago the situation was different, and arsenic as an impurity was a common occurrence in a long list of important chemicals, particularly in those in the manufacture of which sulphuric acid figures.

It should be remembered that volcanic sulphur usually contains arsenic. So do many metallic sulphides. Hence sulphuric acid made from such sulphur, or from pyrites (a metallic sulphide), is apt to be arseniferous. And as sulphuric acid is used in the manufacture of literally hundreds of other chemicals, these in turn may embody the poisonous impurity. Fortunately, such contaminations can easily be detected, to be removed by purification processes. This is now the practice. So we need no longer be apprehensive in regard to the purity of our epsom salt, sodium phosphate, glycerine, glucose, or of our other chemicals which find application in medicine or in food products.

The arsenic hazard is not altogether a modern danger, for the ancient Greeks knew, and used as a paint pigment, the golden yellow mineral which is a sulphide of arsenic, and which in ancient literature was called auri pigmentum, a name from which we derive our present title orpiment. They were familiar also with another arsenical mineral, called realgar, likewise a sulphide, but of a different sulphur-content. This latter pigment, orange-red in color, has in its time, found many uses. It is still employed to tint shellac, and thus it may get into varnishes. Not only that, but shellac is used to a limited extent in the manufacture of certain candies; hence the confectioner is now dependent on the chemical analyst to assure him an arsenic-free shellac for candies.

When modern chemists produced artificially the beautiful green pigments, arsenite of copper, and aceto-arsenite of copper, the latter more generally known as Paris green, both these pigments were promptly appropriated by the paint makers, and furniture, yes, even children's toys, were at one time painted with such poisonous materials. The practice is, however, no longer permitted. Toys may now be handled in safety, and the youngsters may use them as a mechanical help in cutting their baby teeth.

In this connection it is important to note the fact that the name of an arsenic-containing pigment may not disclose its poisonous composition. There is, for example, a large group of *colors* technically called *lakes*. They are produced by chemically combining a soluble dye with a mineral substance. Dyes basic in chemical behavior require that the mineral substance employed in the reaction be acidic; and one of the various acids used in making lakes is arsenous acid, in consequence of which fact we have another group of arsenical pigments, namely, the arsenic-containing lakes. Now lakes are utilized widely in the printing of calico, wall paper and "chromos," including the colored supplement to our Sunday paper. For such purposes lakes which contain arsenic should, of course, be avoided and, as a matter of fact, the danger growing out of the reckless use of such pigments no longer exists. Some years ago, however, arsenical wall paper was all too common, and numerous cases of poisoning due to this source are on record. Why such pigment is dangerous appears when we realize that not only does the print chalk off in course of time, distributing poisonous dust in the room, but that it may in addition yield a gaseous arsenic compound, namely, arsine, AsH_3. The production

of arsine is in these cases due to the action of a living organism, classified by biologists as a mould, and known in scientific circles as penicillium brevicaule. This mould, which might easily be conveyed to the wall paper with the paperhanger's paste, is so effective in decomposing arseniferous pigment that its use has been suggested to the chemical analyst as a possible test agent for arsenic.

Now arsine is probably the most toxic compound of arsenic; and, being a gas, it constitutes a poison which it would be hard to avoid, were it to be slowly generated in one's living room. The compound was discovered in 1815 by a German chemist, named Gehlen, who sniffed it and died. This poison gas has a distinctive smell, a smell suggestive of garlic, and we may be sure that no experienced chemist ignores this odor when it develops in the laboratory, for it is a well-known danger signal. If then a room in a dwelling-house acquires for reasons that are not quite obvious the aroma of an Italian delicatessen store, the wall paper had better be promptly replaced. No one can afford to take chances with arsine.

Arsenic also plays a part in the synthesis of several coal-tar dyes. As a consequence, certain clothing, other textiles, and especially stockings, have on occasions been under suspicion in connection with the development of symptoms of arsenic poisoning. A few years ago a certain black dye, used extensively for coloring stocking yarn, caused some trouble because of a small quantity of arsenic which it contained. As a consequence of the occurrence we now have—believe it or not—an official arsenic limit applicable to stockings: Stockings, be it known, must not contain arsenic in excess of 1/100 grain per square yard, lest they be barred from interstate commerce.

The ubiquity of arsenic, in small traces, is indeed surprising. Even the leather sweatbands in men's hats are sometimes loaded with enough of it to produce skin irritation. Whence the arsenic? Why, arsenous oxide is one of the several dehairing agents used by tanners, which explains why it might occur in leather.

Another use of arsenic—one that need not disturb us—is in the manufacture of clear, colorless glass, such as is used for tumblers, goblets, or baking dishes. The material out of which glass is made, particularly the sand, may contain a little iron, which would tend to color the glass greenish. If such tinting is not desired, the glass maker resorts to one of several expedients to prevent the coloration. One procedure is to add some white arsenic, As_2O_3, to his glass mix-

ture. When this is done, most of the arsenic escapes during the heating; and the trace which remains in the glass, left in form of an insoluble metallic arsenate, is securely imprisoned in the glass substance. It cannot be transmitted to our food or drink. Hence it offers no danger to the user of glass-ware.

In metallurgy arsenic has long been useful. A particularly interesting employment is in the manufacture of bird shot, involving the addition of .3 per cent. to .6 per cent. of elementary arsenic to give greater fluidity to the molten lead, so that it may form spherical and not misshapen drops when it is poured through a colander-like contrivance, from the shot-tower, and into water. Because of its arsenic-content, such shot is also harder after it has become cold. One can't make good shot without arsenic.

The ancient Greeks knew that arsenic could be used to turn copper into a silver-white alloy. The modern metallurgist does not use arsenic for this purpose, but he deposits it electrolytically on copper, or on brass, to effect a black coating or finish.

Even the cement man is planning to use arsenous oxide as a component of concrete to make it resistive to deterioration when it is subjected to high water pressure, or to the destructive action of acid-containing liquids.

Arsenic, in the form of arsenous oxide, is a component of certain brilliant, white fires, known as Bengal fires; and thus we find that this poisonous element plays a modest role in the manufacture of fireworks. Even our Fourth of July celebrations are made more brilliant by this toxic substance.

So it appears that arsenic, an unwelcome impurity in so many compounds, and necessitating expensive refining operations in the production of such chemicals, has real value of its own, and that it may be quite useful. To be sure, we must know how to use it, and how to use it in safety. We must know when its use is justifiable, and when it is not permissible.

Let us now revert to the occurrence of arsenic in nature. It has been shown that this poison is a common impurity in sulphur, and in numerous metallic sulphides, found in ore-pockets in the earth's crust. Hence it would not be surprising if it occurred also in certain mineral springs, particularly in waters from a considerable depth, and in the waters of volcanic regions. Such is in fact the case. Indeed, many of the famous mineral springs of Europe are faintly arseniferous.

Thus the renowned spring at Vichy, France, provides a mineral water which, among other constituents, contains a little arsenic, namely, about two parts per million. The Koch Brunnen in Wiesbaden, the springs at Orsola in the Tyrolean Alps, the Lorenz Quelle in Switzerland, and the waters of numerous other springs in Europe, contain arsenic. So likewise do some of our American spring waters, particularly those of the Yellowstone region;—even Old Faithful, the geyser renowned because of its reliability of performance, and which no visitor to the Yellowstone misses seeing, spouts a little arsenic.

With reference to arsenical mineral waters, it may be said that, although they have been imbibed by countless thousands, no injurious results attributable to the small dosages of arsenic have been noted. Apparently, the poison, in quantities so exceedingly small, is not injurious at all. This is a reassuring and a comforting fact, for it is difficult to keep minute traces of arsenic out of our diet.

As is well known, the waters of the ocean, embodying the leachings of the uppermost strata of the earth's crust, carry countless tons of compounds of arsenic, the content varying from one to eight parts per ten million. And since it is a well-known fact that marine organisms may exhibit the property of selective absorption and assimilation of certain sea-water constituents, with the result that they accumulate in their own tissue higher percentages of such substances than those observed in the fluid in which they live, we need not be surprised to find our sea food more highly arseniferous than ocean water itself. Such is really the fact in respect to crabs, lobsters, clams, oysters, and our edible salt-water fish. Every time we eat cod, for example, or herring, we ingest a small dose of arsenic; and when we take cod-liver oil, we get a slightly larger dose, in proportion, for in fish the arsenic seems to be localized mainly in the fat. There is, however, no danger from arsenic in sea food or its products. One could eat seven or eight pounds of baked cod, or drink an entire pint of cod-liver oil, without incurring danger as far as the arsenic is concerned, for the quantity of the latter involved in such immoderate food portions would not exceed that of a safe medicinal dose of the poisonous substance.

Thus it appears that neither in the spring waters which we might drink, nor in the sea foods so tempting to our palates, nor in the virgin soil the small boy might eat in the erroneous assumption that he is

expected to consume a peck of it before he grows up, is there, naturally, enough arsenic to cause the least alarm.

We now have the further assurance that there are no longer grounds for apprehension because of the possibility of dangerous contaminations with arsenic in medicinal chemicals, and that our modern dyes, and our present-day paints for toys, are reasonably safe to use.

The danger of accidental poisoning by arsenic, as far as the danger exists today, is not incident to its industrial uses, but grows out of the progressively increasing use of arsenical insecticides. This holds good particularly for our own country. America, ranking first in gasoline consumption, in amount of rubber manufactured into tires, and in so many other things, is first also in the quantity of arsenic it produces and consumes. We Americans, if we fail to take heed, bid fair to become the arsenic eaters of modern times.

The industrial source of arsenic is the same as of old. We get most of our arsenic from the dust which collects in the stacks of our copper, lead, zinc, and silver smelters, just as the alchemists got theirs originally from the chimney soot after they had conducted certain metallurgical operations. The product obtained in this manner is not elementary arsenic, but arsenous oxide, As_2O_3, commonly called white arsenic, in contradistinction to the elementary, which is grayish black, and to the two native sulphides, which are yellow and orange-red, respectively.

Besides the huge quantities of arsenic we obtain from our own smelters, we import millions of pounds from Mexico, Belgium, Canada and Japan. And of this great store of arsenic more than one-half is consumed by the insecticide industry. Think of it: in our warfare against insects we distribute annually, on our fields and orchards, lawns and golf courses, a total of nearly 80 millions pounds of arsenic compounds of one kind or another.

We may well ask, do conditions warrant the wholesale distribution of so dangerous a substance as arsenic? Our horticultural experts answer, yes, and, apparently, no one offers a dissenting voice. In Europe, on the contrary, the medical profession has consistently opposed the use of arsenic on fruit trees, and this on the grounds that there was involved too great a risk—too great a danger to the fruit-consuming public. In France, such use of arsenic is in fact prohibited by law. It seems, however, that in our country insect pests are a more serious problem. Our yearly crop damage due to insects is computed

at two billion dollars, a sum which would pay the wages for a year of one million men. The annual loss in our fruit crop, despite our vigorous warfare on insect pests, amounts to 20 per cent. of the total yield. What sort of apples we could expect, if the use of arsenical sprays were to be discontinued, we think we know, and the prospect does not appeal to us. We demand perfect, healthy apples—not gnarly and not wormy. When we bite into an apple, we do not want to find an apple worm—or what would be worse, a half of a worm—in the pulp; so we have become reconciled to the use of arsenical spray as a control measure against the codling moth, and we are hoping and trusting that our apple may not have enough arsenic on its skin to do us any harm.

There are on our statute books no laws prohibiting or regulating the employment of arsenic for insecticidal purposes. We do, however, have national and state food standards, and we depend for our protection largely on the vigilance and the efficiency of our food inspectors. Obviously, it is necessary, notwithstanding such inspection, that we ourselves exercise care and good judgment in the purchase and in the preparation of our fruits and vegetables, for we cannot blink the fact that the extensive use of arsenic to which we have become more or less reconciled does actually involve the potentiality of a degree of danger. Certainly, knowledge of the subject should be widespread and general.

Let us now study the nature of arsenical insecticides somewhat in detail. First of all, let us recall the statement that compounds of arsenic are poison to all forms of life, vegetable as well as animal. Let us bear in mind, further, that if the toxic properties are to become operative, the compound must be soluble, or be decomposable into a product which is soluble. A compound of arsenic, altogether insoluble, and not subject to chemical change under the conditions involved in its use, is not a poison at all. It follows then, that elementary arsenic, because of its insolubility, and its chemical stability, would not prove effective to kill insects on plants. On the other hand, an arsenic compound of high solubility in water could not be employed in a plant spray, for it would scorch and injure the plant foliage. Indeed, sodium arsenite, a soluble salt, is actually made to do service as a weed killer. Of course, if the insecticide is to be put on the soil, and not on plants, soluble arsenicals may be chosen, as in the case of grasshopper bait, which is wheat bran, poisoned with sodium arsenite, sweetened with

blackstrap molasses, and flavored with banana oil. The objection to such a mixture, designed as insect bait, is that it is poisonous not only to insects, but to birds and mammals as well. It should therefore be employed only as a last resort.

Of the compounds of arsenic intended to be used on the plants and for the destruction of insects, the acid lead arsenate $PbHAsO_4$, ranks first in importance, as it is now employed more extensively than any other arsenical. For very delicate foliage, as for plum, peach, cherry, or English walnut trees, the more nearly insoluble basic lead arsenate may be preferred. These two lead salts of arsenic acid have the physical properties which make them particularly suitable for sprays. Next in importance, in point of quantity used, comes calcium arsenate, $Ca_3(AsO_4)_2$, most generally employed not as a spray but as a dusting powder. For this purpose it is diluted with such inert substances as fine clay, ground gypsum, and similar material. Third in importance comes Paris green, chemically, the aceto-arsenite of copper, the arsenical which has been employed longer than any other, namely, since Civil War times, indeed, the first one to be used as a stomach poison to destroy chewing insects. There are in addition other metallic arsenites and arsenates used to a limited extent; and also London purple, which is an arseniferous by-product in the manufacture of a certain coal-tar dye. But the two lead salts, calcium arsenate and Paris green, constitute the great bulk of our arsenical insecticides. It will be observed that each of these compounds is almost insoluble in water. There is, however, a difference, not only in direct solubility, but likewise in the resistance which these compounds offer to decomposition. Hence they cannot be employed interchangeably.

The acid lead arsenate is so nearly insoluble that the rains will not quickly dissolve it off the foliage. There is, however, in the presence of water, a very slow hydrolysis, resulting in the liberation of a little arsenic acid, in accordance with the following equation:

$$5PbHAsO_4 + HOH = Pb_4(PbOH)\ (AsO_4)_3 + 2H_3AsO_4$$

The decomposition goes forward so slowly, and the concentration of the resulting arsenic acid solution is so weak, that only the most delicate foliage can receive injury; and if such vegetation requires spraying, it is customary to add a small quantity of slaked lime to the mixture, for the purpose of re-combining the freed acid. The

alternative procedure is to use the more stabile basic lead arsenate in place of the acid arsenate.

While lead arsenate is but very slightly soluble in pure water, it is chemically acted upon in the presence of either an acid or of a soluble alkali. Hence it is that when an insect—or a mammal, for that matter—eats it, the digestive fluids will produce soluble arsenic compounds, and these, as may be expected, will promptly exert their toxic action.

The calcium arsenate and the Paris green are both used more generally as a *dusting powder* than in a spray. In either case, however, the fact that water, especially in the presence of carbon dioxide, liberates arsenic acid from the calcium salt, and arsenous acid from the Paris green, makes desirable the addition of lime, in order that the foliage be protected against injury.

If the arsenic compounds are to be used as a spray, they must be in fine powder so as to admit of proper suspension in water, and the particles should possess the property of adhering tenaciously to the foliage. Both the acid and the basic lead arsenate exhibit these characteristics. To further increase the stickiness of acid lead arsenate, it may, in its manufacture, be given a coating of lead oleate, a thin film of which is made to cover each particle of the arsenate. The coating represents only about two per cent. of the total weight of such a product, but it increases its value materially for certain purposes. Thus it has been observed that the Japanese beetle, a pest that is disinclined to feed on foliage covered with common lead arsenate, is seemingly quite willing to eat the coated arsenical;—certainly, the latter kind kills more beetles.

For the control of insects in our northern orchards, the two lead arsenates are preferred to all other arsenicals. The typical acid lead arsenate spray employed contains about five to six pounds of the poison to a hundred gallons. To favor its adhesion the spray mixture is made to include such sticky materials as flour, calcium caseinate, glucose or molasses, which in addition serve the further purpose of making the poison more tempting to the insects.

It may also be advantageous, under certain circumstances, to incorporate a fungicide, like Bordeaux mixture, if the trees or vines require such treatment. Thus it becomes apparent that not all the spray residue noticed on a fruit is necessarily arsenate of lead. It

should, however, be our regular practice to deal with such residues as dangerously poisonous, for frequently this is really the fact.

In the southern states *dusting* with calcium arsenate is a common practice. This procedure was first employed on a large scale in combatting the cotton-boll weevil; it is now used quite generally in treating also other field and garden crops. The calcium arsenate, which must be in very fine subdivision, is for this purpose mixed with inert material—clay, fuller's earth, ground gypsum, slaked lime, or even street dust. For orchard *dusting,* the calcium salt may be replaced by lead arsenate, the latter being less injurious to the foliage. The dusting method, it appears, is growing in popularity, possibly because it can be carried out more quickly, and perhaps more economically. In the orchards of our northern states it is frequently resorted to as a supplementary treatment, when it is found that the initial spraying has ceased to afford ample protection and that a new brood of insects is making its appearance.

Primitive, wasteful, hit or miss method of dusting with calcium arsenate. Should not be permitted except on cotton plants. Certainly not on cabbages.

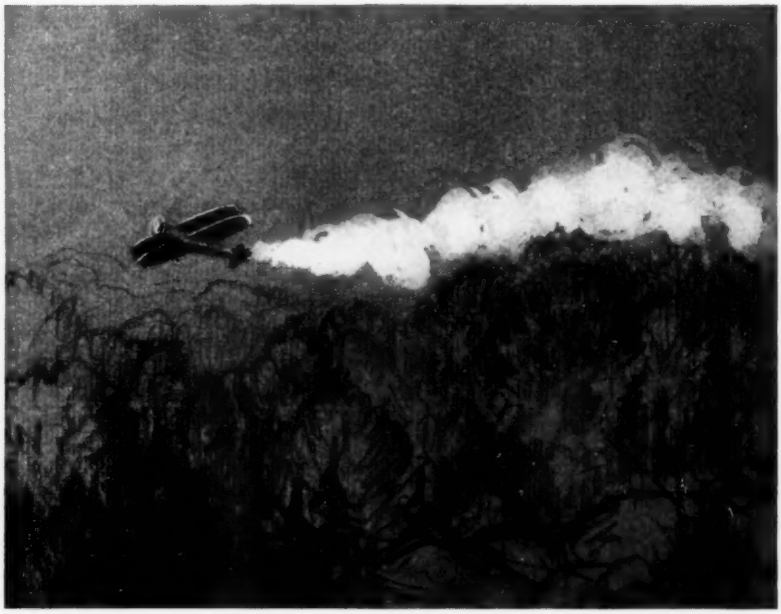
The machinery for the dusting, and for the spraying as well, was, at the outset, quite primitive. For dusting, a big pepper shaker, improvised from a tin bucket, and worked by hand. Or two burlap bags, carried on a pole, held crosswise over the back of a mule, guided by its rider to jog along between the rows of growing vegetables. The application of the insecticide was, when applied in this manner, far from uniform, some plants received more, some less;—it all depended upon the mule. Naturally, the method was extremely wasteful as well as uncertain. Common horse sense required that the mule method be discontinued.

The original appliance for spraying was a simple hand pump and a water pail. It is a far cry from a mechanism so primitive, to huge tanks on motors with air compressors capable of furnishing pressure as high as a thousand pounds, making it possible to cover with arsenical spray the largest fruit or shade trees. Indeed, even the forests on the slopes of our mountains may be protected against insects, for *dusting* is now accomplished with aeroplanes wherever spraying is not

Spraying fruit trees in the Japanese beetle area with lead arsenate.

feasible. This latter method—aeroplane dusting—is now employed as a regular routine on the large cotton plantations of the South. It has been used, further, and with outstanding success, to poison with Paris green the swamps and stagnant pools in which breeds the malaria-transmitting mosquito, the anopheles quadrimaculatus. Thus by the use of arsenic vast areas, formerly malaria-ridden, have been made habitable. In our grandfathers' day malaria, called ague, was prevalent throughout the South and throughout the entire Mississippi Valley; and in treating the ailment, the physicians at that time had recourse to two remedial agents, namely, quinine and a preparation of arsenic. It is interesting to note that arsenic not as a medicine for the patient ill with the disease, but arsenic as a poison to kill the malaria-carrier, has been pre-eminently effective in conquering this dreadful malady, which has played a conspicuous role in retarding the progress of civilization in certain sections of our country, and has been the cause of so much human misery.

But isn't there some danger in distributing these millions of pounds of poison on swamps, ponds, forests, orchards, vineyards and



Aeroplane dusting. Calcium arsenate is most generally the insecticide employed.

gardens? If it is a necessity that this be done—and apparently it is—can we live in safety and with the feeling of security in this modern Age of Arsenic? Of course there is danger. There are indeed many new hazards in our modern modes of life. Arsenic is responsible for one of them. We must learn how to avoid the dangers of our times just as our remote ancestors had to learn to cope with the dangers of the jungle.

The question is sometimes asked, what about our soil, once so harmless, now becoming, in certain sections, increasingly arseniferous; —is there danger lurking in our soil? In answer, it may be said that, with the possible exception of the soil on golf courses in the Japanese beetle area, where great quantities of lead arsenate are employed to kill the beetle grub, the arsenic in soil has not, so far, presented a serious problem. The composition of soil is most complex. There are the mineral constituents, and the decomposition products of vegetation; and the living organisms, such as bacteria, protozoa and fungi, which by virtue of their life processes bring about chemical changes. Hence it is difficult to make a sweeping statement in regard to the ultimate disposal of lead arsenate after it has become a part of the soil. We know that the acid salt is very slowly transformed into a basic salt, with the liberation of small quantities of arsenic acid. We know also that the presence of acids or of alkalies would accelerate the production of water-soluble arsenic compounds. It appears, however, that no appreciable quantities of arsenic have up to the present time been discovered in our brooks, springs or wells. It may be that lime in the soil, or oxide of iron, tend to fix the free acid in the form of insoluble compounds. There is, further, no evidence of harmful quantities of arsenic having been assimilated by the higher plants. It seems, therefore, that we need not hesitate to grow garden crops in arseniferous soil, although it would be obviously unwise to let small children play in orchards where spraying with arsenicals is a regular practice.

The real arsenic danger, however, confronts us from another direction, and it grows out of the fact that our fruits and vegetables may carry spray residue, or residue from a *dusting* treatment with arsenical insecticide. The danger is probably not as great in case of fruit as in connection with the use of vegetables. Any appreciable amount of spray residue left on apples is noticeable. Moreover, most of the lead arsenate occurring on apples is to be found in the stem

cavity, and in the blossom or calyx cavity,—and but few people eat the core. Finally, if the apple is peeled and quartered, or peeled and cored, as for baking, the danger of arsenic is practically eliminated. In case of vegetables the spray residue is not so noticeable, nor is there the chance of removing the deposit by peeling.

It might be stated in this connection as a reassuring fact that apples grown in the northeastern states seldom exhibit excessive spray residue, for in these regions the spraying is limited to the earlier weeks of the growing season. In the apple belt along the Pacific coast, however, climatic conditions favor the appearance of numerous broods of destructive insects during a long summer, and for this reason spraying treatment must be extended late into the growing season. As a consequence western apples are more apt to carry excessive spray residue; —that is, unless it has been removed by washing the apples in very dilute hydrochloric acid, a procedure now generally followed, by western apple growers who have been forced to install special apple-washing machines, in order that their fruit may meet the requirements for interstate shipment.

It is a good thing for all of us that fruits and vegetables, as well as other foods, are subject to inspection and that they must conform to federal regulations and standards of purity and of wholesomeness, if they are to enter interstate commerce. As regards apples, as much as 1/100 grain (when calculated to arsenous oxide) is permitted of any arsenical insecticide per pound of fruit. This minute quantity is generally deemed harmless, and we may assume that such is the case. It would mean the equivalent of a medicinal dose of arsenic in about three pounds of apples, if one were to eat the entire apple, peelings, core, and all. Notwithstanding this inspection it is a wise precaution to examine our apples for spray residue, particularly as to the stem and the blossom cavity. If a white deposit is in evidence, this may be nothing more harmful than a little lime; then again it might be lead arsenate. It is, therefore, wise to either thoroughly wash or to peel such apples. And if we are careful, and do take these precautionary measures, we may in perfect safety retain as a part of our regular diet this wholesome and palatable fruit, the apple.

In regard to cider, we meet the difficulty that visual inspection is not of much value. There is cider—and cider. It may have been made from sound and perfect fruit, carefully washed, or it may have been made from unwashed windfalls. It may come from a locality

where frequent spraying is unnecessary, or from a region where trees are sprayed many times through the summer. Hence it is well to purchase this beverage from reliable sources. Federal, state and local food inspectors have on occasion found it necessary to confiscate cider because it contained arsenic in excess of the permitted amount. These facts apply with equal significance to cider vinegar, which is likely to be contaminated with arsenic if it is made from arsenic-containing cider. There is this distinction, however, that vinegar is consumed in much smaller quantities, and for this reason is less dangerous than cider.

Another fruit which now requires inspection is the grape. For many years Bordeaux mixture, made from copper sulphate and lime, and hence a suspension of copper hydroxide, was the only spray used on grape vines. Since the advent of the Japanese beetle, which has a preference for this vine, it has become necessary to employ also, in the beetle area, an arsenical spray, usually lead arsenate. In tests carried out in the chemical laboratory of the Philadelphia College of Pharmacy and Science on the skins of grapes grown in the New Jersey beetle area, and representing fruit which had been sprayed, as was definitely established, in the first week of July, the arsenic-content proved to be negligible. A great deal, of course, depends upon the time of the last spraying, and upon the weather conditions thereafter. The voracious Japanese beetle has, in our own locality particularly, made necessary the distribution of great quantities of lead arsenate—on cherries, plums, peaches, berries, grapes, as well as on apples. All these fruits must now be carefully examined before they are eaten.

Despite the very general employment of orchard sprays, the use of fruits does not involve a really serious hazard because of arsenic, provided, of course, that we exercise necessary precautions. We cannot say the same about our vegetables. It seems that every vegetable now has its particular insect pest, threatening to destroy it unless control measures are employed, and these procedures usually involve the use of an arsenical. Cabbages, cauliflower, celery, broccoli, peas, beans, spinach, lettuce, even the pungent onion—all may require the protection of an insecticide. In the southern states, whence comes our winter supply of fresh vegetables, climatic conditions are such as to favor insect activity throughout the entire year, without a dormant period. And for this reason the greens that reach our table during the winter months are specially likely to carry spray residue. It is indeed fortu-

nate that we now have efficient food inspection. Even at that it is well to be conservative as to winter cabbage, for it must be exceedingly difficult to keep all arsenical cabbage off the market. When the spraying or the dusting of the cabbage plants is done with modern equipment, the deposit of insecticide is fairly uniform, and the arsenic-content of one cabbage head is likely to be pretty nearly the same as that of another from the same field. When, however, primitive methods are employed, there is the possibility of getting many times as much insecticide on one plant as on its neighbor in the same row; and if the poison is applied when the heads are beginning to form, some of it may be closed in between the leaves, in which case our only chance of keeping arsenic out of our salad lies in governmental inspection and seizure.

It appears then that of the many and various paternalistic activities of government, food inspection is one which under modern conditions of life has become a necessity. It's an activity which should not be affected by economy programs. An adequate force of chemical experts, and others, in charge of federal, state and local food inspection, should be maintained, for these servants in the interest of public health have become as necessary to our safety as the life-guards on our bathing beaches.

It seems strange that truck farmers and orchardists, are, speaking generally, uninformed as to the serious possibilities which may grow out of the careless use of arsenical insecticides. A campaign of education on this point is clearly indicated, and it may accomplish great good, for our farmers and fruit growers do not lack in a feeling of responsibility, but lack only in knowledge.

Some day modern chemistry may produce a substitute for the arsenical insecticides in the form of a compound toxic as a stomach poison to the chewing insects, but harmless to man. What a boon such a discovery would be! But until this discovery materializes arsenic will continue to be responsible for one of the hazards of modern life.

HISTORY OF CHEMISTRY READER

1. THE SCEPTICAL CHYMIST

By Robert Boyle

1661

Arranged by Edward Kremers for Reading by Students of the History of Chemistry

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Preface

OF THE works of Robert Boyle, member of The Invisible College at Oxford, and a founder of the Royal Society (1663), possibly none is more universally known by title than his *Sceptical Chymist* (1661). Yet, out of a group of one hundred chemists of today, possibly not one may claim to have read this treatise that had so profound an influence on scientific thought. Nevertheless, it is one of the comparatively few scientific treatises regarded as of sufficient general interest to be reprinted in *Everyman's Library*. Concerning it, Pattison Muir, the English chemical historian, makes the following statement in his introduction to the reprint referred to "The *Sceptical Chymist* upholds the claim of scientific method to be also the true method of philosophy. Not only because of the universality and importance of the particular scientific questions wherewith it is concerned, but also because of the human interests that vitalise every attempt to determine the nature of truth, and the ways of gaining truths. The *Sceptical Chymist* is a real, living book for intelligent men and women today."

To the modern chemist, Boyle's treatise is of special interest because "he enunciated the axiom that only what can be demonstrated to be the undecomposable constituents of bodies are to be regarded as elements; and he considered it hazardous to advance opinions as to the properties of the elements in general, without first having obtained a firm foundation in their actual properties individually. With a far-seeing glance he looked forward to the discovery of a much greater number of elements than was at that time assumed, at the same time contending that many of the substances then held to be elementary were not really so."

In the following dramatization, if such a term be applicable to the slight rearrangement of the text, the prefatory chapter on "Physiological Considerations touching the experiments wont to be em-

ployed to evince either the four peripatetick elements, or the three chymical principles of mixt bodies" is utilized in the hope that the taste thus afforded may stimulate the appetite for more. Inasmuch as the average chemical reader cannot be expected to analyze the historical character of the five persons who take part in the discussion, the introductory remarks of the *Dramatis Personae* have been supplied for a better appreciation of the stage setting as it were. As an exercise for our undergraduate classes in the history of chemistry, the rearranged text may not prove unwelcome to the teachers of this subject.

DRAMATIS PERSONAE

Eleuthereus (1), (Non-partisan chairman)
Author (2), (Secretary)
Disputants
Themistius (3), ("Peripatetic" or Aristotelian)
Philoponus (4), ("Chymist" or Paracelist)
Carneades (5), (Sceptic)

(1) Eleutherios is a synonym for Zeus, the head of the Olympian gods, originally nature deities. As such he was the god of heaven, of the heavenly fire (lightning) and of light. Later his personality was clarified as that of the almighty and allseeing ruler of the world, the fount and protector of law and order. He acquires numerous cognomens. Thus as Zeus Eleutherios he was the deliverer from evil.

It is Eleutherius who invites the "author" to visit his friend Carneades at whose house they find not only Carneades but also Philoponus and Themistius sitting in an arbor of the garden "about a little round table, on which, besides paper, pen and ink, there lay two or three open books." They had apparently been talking about the very problems, the discussion of which was later on resumed in the presence of the two newcomers.

Eleuthereus wished to remain a listener, but was finally persuaded to take part in the discussion provided he might be "permitted according to the freedom of his genius and principles to side with one of them in the managing of one argument, and, if he saw cause, with his antagonist, in the prosecution of another, without being confined to stick to any one party or opinion." Thus Eleuthereus as non-partisan becomes chairman of the debate, as it were, and the disputants, thereafter, address their remarks largely to him.

(2) Although the author, like Eleutherius, had begged to be permitted to remain listener, he also is not allowed to remain absolutely passive. Finally, they agreed that he "should register their arguments, that (he) might be the better able after the conclusion of their conference to give them (his) sense upon the subject of it (the number of elements or principles), which (was) promised (he) should do at the end of the present debates, if time would permit, or else at (their) next meeting."

(3) Themistius is the follower of the peripatetic or Aristotelian doctrine of the four elements. As the representative of the oldest school, he is given the first opportunity to present his case. He naturally deplores being held to experimental evidence in accordance with the rules of debate agreed upon and would greatly have preferred to philosophise, regarding *a priori* discoveries (reasoning) more highly than those *a posteriori* (experimental evidences), preferring also to use the experiment to illustrate rather than to demonstrate.

(4) Philoponus, the "chymist," or follower of Paracelsus, is the defender of the three elements. He belongs to that school of which Themistius states that he scarcely knows "anything they have performed worth wondering at, save that they have been able to draw Philoponus to their party, and to engage him to a defense of an unintelligible hypothesis."

(5) Karneades, a Greek philosopher, and founder of the New Academy, was born in Kyrene and lived between 214 and 129 B. C. Together with Diogenes, the stoic, and Kritolaus, the peripatetic, he was sent, in 165 B. C., as ambassador to Rome where he created a sensation by his ability to speak against as well as for law and justice with equally brilliant dialectic.

He supplemented the sceptical teachings of Arsilaus by means of a well worked out theory of probability. For all practical purposes probability was to take the place of certain knowledge, which he regarded as unattainable. The natural result was that such a doctrine swept away all other tenets, for "those who hold that there is no such thing as certain human knowledge cannot consistently assert unqualified belief in any other doctrine whatsoever."*

This philosophic attitude affords the keynote to the part played in the discussion by Carneades, the sceptic. It is not at all necessary for him to prove how many elements (or qualities) there may be, all

*Nutting, *Cicero's Tusculan Disputations*, p. XVI.

he has to is to prove that the four Aristotelian elements are not based on experimental evidence and that this is likewise true of the three fundamental qualities of Paracelsus. His criticism need not be constructive. Nevertheless, it has its value in so far as it removes a blind faith in the current doctrines based on speculation rather than experimental evidence, and prepares the mind for the truth which may come to him who is willing to see and learn, but not to him who is blindly devoted to preconceived notions. This position has been historically justified, for, although Boyle did not prove the Moses destined to conduct chemists into the holy land of the real chemical elements, he nevertheless was a voice in the wilderness preparing the way.

AUTHOR-SECRETARY: I perceive that divers of my friends have thought it very strange to hear me speak so irresolvedly, as I have been wont to do, concerning those things which some take to be the elements, and others to be the principles of all mixt bodies. But I blush not to acknowledge that I much less scruple to confess that I doubt when I do so, than to profess that I know what I do not: and I should have much stronger expectations than I dare yet entertain, to see philosophy solidly established, if men would more carefully distinguish those things that they know from those that they ignore or do but think, and then explicate clearly the things they conceive they understand, acknowledge ingenuously what it is they ignore, and profess so candidly their doubts, that the industry of intelligent persons might be set on work to make further enquiries, and the easiness of less discerning men might not be imposed on. But because a more particular accompt will probably be expected of my unsatisfiedness not only with the peripatetic, but with the chymical doctrine of the primitive ingredients of bodies: it may possibly serve to satisfy others of the excusableness of my dissatisfaction to peruse the ensuing relation of what passed a while since at a meeting of persons of several opinions, in a place that need not here be named; where the subject, whereof we have been speaking, was amply and variously discoursed of.

It was on one of the fairest dayes of this summer that the inquisitive Eleutherius came to invite me to make a visit with him to his friend Carneades. I readily consented to this motion, telling him that if he would but permit me to go first and make an excuse at a place not far off, where I had at that hour appointed to meet, but not about a business either of moment, or that could not well admit of a delay, I would presently wait on him, because of my knowing Carneades to

be so conversant with nature and with furnaces, and so unconfined to vulgar opinions, that he would probably by some ingenious paradox or other give our mindes at least a pleasing exercise, and perhaps enrich them with some solid instruction. Eleutherius then first going with me to the place where my apology was to be made, I accompanied him to the lodging of Carneades, where when we were come, we were told by the servants that he was retired with a couple of friends (whose names they also told us) to one of the arbours in his garden, to enjoy under its coole shades a delightful protection from the yet troublesome heat of the sun.

Eleutherius being perfectly acquainted with that garden immediately led me to the arbour, and relying on the intimate familiarity that had been long cherished betwixt him and Carneades; in spite of my reluctancy to what might look like an intrusion upon his privacy, drawing me by the hand, he abruptly entered the arbour, where we found Carneades, Philoponus, and Themistius, sitting close about a little round table, on which, besides paper, pen, and inke, there lay two or three open books; Carneades appeared not at all troubled at this surprise, but rising from the table, received his friend with open looks and armes, and welcoming me also with his wonted freedom and civility, invited us to rest ourselves by him, which, as soon as we had exchanged with his two friends (who were ours also) the civilities accustomed on such occasions, we did. And he presently after we had seated ourselves, shutting the books that lay open, and turning to us with a smiling countenance, seemed ready to begin some such unconcerning discourse as is wont to pass, or rather waste, the time in promiscuous companies.

But Eleutherius guessing at what he meant to do, prevented him by telling him, I perceive, Carneades, by the books that you have been now shutting, and much more by the posture wherein I found persons so qualified to discourse of serious matters, and so accustomed to do it, that you three were, before our coming, engaged in some philosophical conference, which I hope you will either prosecute, and allow us to be partakers of, in recompense of the freedome we have used in presuming to suprise you, or else give us leave to repair the injury we should otherwise do you, by leaving you to the freedom we have interrupted, and punishing ourselves for our boldness by depriving ourselves of the happiness of your company.

(*With these last words Eleuthereus and the Secretary rise as if they meant to be gone; but Carneades suddenly laying hold on his arm, and stopping him by it, smilingly tells him.*)*

CARNEADES: We are not so forward to lose good company as you seem to imagine; especially since you are pleased to desire to be present at what we shall say about such a subject as that you found us considering. For that, being the number of the elements, principles, or material ingredients of bodies, is an enquiry whose truth is of that importance, and of that difficulty, that it may as well deserve, as require, to be searched into by such skilful indagators of nature as yourselves. And therefore we sent to invite the bold and acute Leucippus to lend us some light by his atomical paradox, upon which we expected such pregnant hints, that 'twas not without a great deal of trouble that we had lately word brought us that he was not to be found; and we had likewise begged the assistance of your presence and thoughts, had not the messenger we employed to Leucippus informed us that as he was going he saw you both pass by towards another part of the town; and this frustrated expectation of Leucippus his company, who told me but last night that he would be ready to give me a meeting where I pleased to-day, having very long suspended our conference about the freshly mentioned subject, it was so newly begun when you came in, that we shall scarce need to repeat anything to acquaint you with what had passed betwixt us before your arrival, so that I cannot but look upon it as a fortunate accident that you should come so seasonably, to be not hearers alone, but we hope interlocutors at our conference. For we shall not only allow of your presence at it, but desire your assistance in it; which I add both for other reasons, and because though these learned gentlemen (*turning to his two friends*) need not fear to discourse before any auditory, provided it be intelligent enough to understand them, yet for my part (*with a new smile*) I shall not dare to vent my unpremeditated thoughts before two such critics, unless by promising to take your turnes of speaking, you will allow me mine of quarrelling with what has been said.

SECRETARY: He and his friends added divers things to convince us that they were both desirous that we should hear them, and resolved against our doing so, unless we allowed them sometimes to hear us. Eleutherius, after having a while fruitlessly endeavoured to obtain leave to be silent, promised he would not be so alwayes, provided that

*The remarks in Italics are not to be read, but enacted if practicable.

he were permitted according to the freedom of his genius and principles to side with one of them in the managing of one argument, and, if he saw cause, with his antagonist, in the prosecution of another without being confined to stick to any one party or opinion, which was after some debate accorded him. But, I conscious of my own disabilities, told them resolutely that I was as much more willing, as more fit, to be a hearer than a speaker among such knowing persons, and on so abstruse a subject. And that therefore I beseeched them without necessitating me to proclaim my weaknesses, to allow me to lessen them by being a silent auditor of their discourses: to suffer me to be at which I could present them no motive, save that their instructions would make them in me a more intelligent admirer. I added that I desired not to be idle whilst they were imployed, but would if they pleased, by writing down in shorthand what should be delivered, preserve discourses that I knew would merit to be lasting. At first Carneades and his two friends utterly rejected this motion; and all that my resoluteness to make use of my ears, not tongue, at their debates could do, was to make them acquiesce in the proposition of Eleutherius, who thinking himself concerned, because he brought me thither, to afford me some faint assistance, was content that I should register their arguments, that I might be the better able after the conclusion of their conference to give them my sense upon the subject of it (the number of elements or principles), which he promised I should do at the end of the present debates, if time would permit, or else at our next meeting. And this being by him undertaken in my name, though without my consent, the company would by no means receive my protestation against it, but casting, all at once, their eyes on Carneades, they did by that and their unanimous silence, invite him to begin.

(*After a short pause, during which he turned himself to Eleutherius and the Secretary.*)

CARNEADES: Notwithstanding the subtile reasonings I have met with in the books of the peripatetics, and the pretty experiments that have been shewed me in the laboratories of chymists, I am of so diffident or dull a nature, as to think that if neither of them can bring more cogent arguments to evince the truth of their assertion than are wont to be brought, a man may rationally enough retain some doubts concerning the very number of those material ingredients of mixt bodies, which some would have us call elements, and others principles. Indeed when I considered that the tenets concerning the elements are as considerable amongst the doctrines of natural philosophy, as the

elements themselves are among the bodies of the universe, I expected to find those opinions solidly established, upon which so many others are superstructed. But when I took the pains impartially to examine the bodies themselves that are said to result from the blended elements, and to torture them into a confession of their constituent principles, I was quickly induced to think that the number of the elements has been contended about by philosophers with more earnestness than success. This unsatisfiedness of mine has been much wondered at by these two gentlemen (*at which words he pointed at Themistius and Philoponus*), who though they differ almost as much betwixt themselves about the question we are to consider, as I do from either of them, yet they both agree very well in this, that there is a determinate number of such ingredients as I was just now speaking of, and that what that number is I say not, may be (for what may not such as they persuade?), but is wont to be clearly enough demonstrated both by reason and experience. This has occasioned our present conference. For our discourse this afternoon, having fallen from one subject to another, and at length settled on this, they proffered to demonstrate to me, each of them the truth of his opinion, out of both the topics that I have freshly named. But on the former (that of reason strictly so taken) we declined insisting at the present, lest we should not have time enough before supper to go through the reasons and experiments too. The latter of which we unanimously thought the most requisite to be seriously examined. I must desire you then to take notice, gentlemen, that my present business doth not oblige me so to declare my own opinion on the subject in question as to assert or deny the truth either of the peripatetic or the chymical doctrine concerning the number of the elements, but only to shew you that neither of these doctrines hath been satisfactorily proved by the arguments commonly alledged on its behalfe. So that if I really discern (as perhaps I think I do) that there may be a more rational account than ordinary, given of one of these opinions, I am left free to declare myself of it, notwithstanding my present engagement, it being obvious to all your observation, that a solid truth may be generally maintained by no other than incompetent arguments. And to this declaration I hope it will be needless to add, that my task obliges me not to answer the arguments that may be drawn either for Themistius's or Philoponus's opinion from the topic of reason, as opposed to experiments; since 'tis these only that I am to examine, and not all of these neither, but such of them alone as either

of them shall think fit to insist on, and as have hitherto been wont to be brought either to prove that 'tis the four peripatetic elements, or that 'tis the three chymical principles that all compounded bodies consist of. These things I thought myself obliged to premise, partly lest you should do these gentlemen (*pointing at Themistius and Philoponus, and smiling on them*) the injury of measuring their parts by the arguments they are ready to propose, the lawes of our conference confining them to make use of those that the vulgar of philosophers (for even of them there is a vulgar) has drawn up to their hands; and partly that you should not condemn me of presumption for disputing against persons over whom I can hope for no advantage, that I must not derive from the nature or rules of our controversy, wherein I have but a negative to defend, and wherein too I am like on several occasions to have the assistance of one of my disagreeing adversaries against the other.

SECRETARY: Philoponus and Themistius soon returned this compliment with civilities of the like nature, in which Eleutherius perceiving them engaged, to prevent the further loss of that time of which they were not like to have very much to spare, he minded them that their present business was not to exchange compliments, but arguments: and then addressing his speech to Carneades.

ELEUTHERIUS: I esteem it no small happiness that I am come here so luckily this evening. For I have been long disquieted with doubts concerning this very subject which you are now ready to debate. And since a question of this importance is to be now discussed by persons that maintain such variety of opinions concerning it, and are both so able to enquire after truth, and so ready to embrace it by whomsoever and on what occasion soever it is presented them; I cannot but promise myself that I shall before we part, either lose my doubts or the hopes of ever finding them resolved (*Eleutherius paused not here; but to prevent their answer, added almost in the same breath*); and I am not a little pleased to find that you are resolved on this occasion to insist rather on experiments than syllogismes. For I, and no doubt you, have long observed, that those dialectical subtleties, that the schoolmen too often employ about physiological mysteries, are wont much more to declare the wit of him that uses them, than increase the knowledge or remove the doubts of sober lovers of truth. And such captious subtleties do indeed often puzzle and sometimes silence men, but rarely satisfy them. Being like the tricks of jugglers, whereby men

doubt not but they are cheated, though oftentimes they cannot declare by what flights they are imposed on. And therefore I think you have done very wisely to make it your business to consider the phænomena relating to the present question, which have been afforded by experiments, especially since it might seem injurious to our senses, by whose mediation we acquire so much of the knowledge we have of things corporal, to have recourse to far-fetched and abstracted ratiocinations, to know what are the sensible ingredients of those sensible things that we daily see and handle, and are supposed to have the liberty to untwist (if I may so speak) into the primitive bodies they consist of.

SECRETARY: He annexed that he wished therefore they would no longer delay his expected satisfaction, if they had not, as he feared they had, forgotten something preparatory to their debate; and that was to lay down what should be all along understood by the word principle or element. Carneades thanked him for his admonition, but told him that they had not been unmindful of so requisite a thing. But that being gentlemen and very far from the litigious humour of loving to wrangle about words, or terms, or notions as empty, they had before his coming in readily agreed promiscuously to use when they pleaded, elements and principles as terms equivalent: and to understand both by the one and the other, those primitive and simple bodies of which the mixt ones are said to be composed, and into which they are ultimately resolved. And upon the same account we agreed to discourse of the opinions to be debated, as we have found them maintained by the generality of the assertors of the four elements of the one party, and of those that receive the three principles on the other, without tying ourselves to enquire scrupulously what notion either Aristotle or Paracelsus, or this or that interpreter or follower of either of those great persons, framed of elements or principles; our design being to examine, not what these or those writers thought or taught, but what we find to be the obvious and most general opinion of those who are willing to be accounted favourers of the peripatetic or chymical doctrine concerning this subject.

ELEUTHERIUS: I see not why you might not immediately begin to argue, if you were but agreed which of your two friendly adversaries shall be first heard.

SECRETARY: And it being quickly resolved on that Themistius should first propose the proofs for his opinion, because it was the antienter, and the more general, he made not the company expect long

before he thus addressed himself to Eleutherius, as to the person least interested in the dispute.

THEMISTIUS: If you have taken sufficient notice of the late confession which was made by Carneades, and which (though his civility dressed it up in complimental expressions) was exacted of him by his justice, I suppose you will be easily made sensible, that I engage in this controversie with great and peculiar disadvantages, besides those which his parts and my personal disabilities would bring to any other cause to be maintained by me against him. For he justly apprehending the force of truth, though speaking by no better a tongue than mine, has made it the chief condition of our duel, that I should lay aside the best weapons I have, and those I can best handle; whereas if I were allowed the freedom, in pleading for the four elements, to employ the arguments suggested to me by reason to demonstrate them, I should almost as little doubt of making you a proselyte to those unsevered teachers, Truth and Aristotle, as I do of your candour and your judgment. And I hope you will however consider, that that great favourite and interpreter of nature, Aristotle, who was (as his *Organum* witnesses) the greatest master of logic that ever lived, disclaimed the course taken by other petty philosophers (antient and modern), who not attending the coherence and consequences of their opinions, are more solicitous to make each particular opinion plausible independently upon the rest, than to frame them all so, as not only to be consistent together, but to support each other. For that great man in his vast and comprehensive intellect, so framed each of his notions, that being curiously adapted into one systeme, they need not each of them any other defence than that which their mutual coherence gives them: as 'tis in an arch, where each single stone, which if severed from the rest would be perhaps defenceless, is sufficiently secured by the solidity and entireness of the whole fabric of which it is a part. How justly this may be applied to the present case, I could easily shew you, if I were permitted to declare to you, how harmonious Aristotle's doctrine of the elements is with his other principles of philosophy; and how rationally he has deduced their number from that of the combinations of the four first qualities from the kinds of simple motion belonging to simple bodies, and from I know not how many other principles and phænomena of nature, which so conspire with his doctrine of the elements, that they mutually strengthen and support each other. But since 'tis forbidden me to insist on reflections of this kind, I

must proceed to tell you, that though the assertors of the four elements value reason so highly, and are furnished with arguments enough drawn from thence, to be satisfied that there must be four elements, though no man had ever yet made any sensible trial to discover their number, yet they are not destitute of experience to satisfie others that are wont to be more swayed by their senses than their reason. And I shall proceed to consider the testimony of experience, when I shall have first advertised you, that if men were as perfectly rational as 'tis to be wished they were, this sensible way of probation would be as needless as 'tis wont to be imperfect. For it is much more high and philosophical to discover things *a priore* than *a posteriore*. And therefore the peripatetics have not been very solicitous to gather experiments to prove their doctrines, contenting themselves with a few only, to satisfy those that are not capable of a nobler conviction. And indeed they employ experiments rather to illustrate than to demonstrate their doctrines, as astronomers use sphæres of pasteboard, to descend to the capacities of such as must be taught by their senses, for want of being arrived to a clear apprehension of purely mathematical notions and truths. I speak thus, Eleutherius, only to do right to reason, and not out of diffidence of the experimental proof I am to alledge. For though I shall name but one, yet it is such a one as will make all other appear as needless as itself will be found satisfactory. For if you but consider a piece of green wood burning in a chimney, you will readily discern in the disbanded parts of it the four elements, of which we teach it and other mixt bodies to be composed. The fire discovers itself in the flame by its own light; the smoake by ascending to the top of the chimney, and there readily vanishing into air, like a river losing itself in the sea, sufficiently manifests to what element it belongs and gladly returnes. The water in its own form boiling and hissing at the ends of the burning wood betrays itself to more than one of our senses; and the ashes by their weight, their firiness, and their dryness, put it past doubt that they belong to the element of earth. If I spoke to less knowing persons, I would perhaps make some excuse for building upon such an obvious and easie analysis, but 'twould be, I fear, injurious, not to think such an apology needless to you, who are too judicious either to think it necessary that experiments to prove obvious truths should be far-fetched, or to wonder that among so many mixt bodies that are compounded of the four elements, some of them should upon a slight analysis manifestly exhibite the ingredients they consist

of. Especially since it is very agreeable to the goodness of nature to disclose, even in some of the most obvious experiments that men make, a truth so important and so requisite to be taken notice of by them. Besides that our analysis by how much the more obvious we make it, by so much the more suitable it will be to the nature of that doctrine which 'tis alledged to prove, which being as clear and intelligible to the understanding as obvious to the sense, 'tis no marvel the learned part of mankind should so long and so generally imbrace it. For this doctrine is very different from the whimseys of chymists and other modern innovators, of whose hypotheses we may observe, as naturalists do of less perfect animals, that as they are hastily formed, so they are commonly short-lived. For so these, as they are often framed in one week, are perhaps thought fit to be laughed at the next; and being built perchance but upon two or three experiments are destroyed by a third or fourth, whereas the doctrine of the four elements was framed by Aristotle after he had leisurely considered those theories of former philosophers which are now with great applause revived as discovered by these latter ages; and had so judiciously detected and supplied the errors and defects of former hypotheses concerning the elements, that his doctrine of them has been ever since deservedly embraced by the lettered part of mankind: all the philosophers that preceded him having in their several ages contributed to the compleatness of this doctrine, as those of succeeding times have acquiesced in it. Nor has an hypothesis, so deliberately and maturely established, been called in question till in the last century Paracelsus and some few other sooty empirics, rather than (as they are fain to call themselves) philosophers, having their eyes darkened, and their braines troubled with the smoak of their own furnaces, began to rail at the peripatetic doctrine, which they were too illiterate to understand, and to tell the credulous world, that they could see but three ingredients in mixt bodies; which to gain themselves the repute of inventors, they endeavoured to disguise by calling them, instead of earth, and fire, and vapour, salt, sulphur, and mercury; to which they gave the canting title of hypostatical principles. But when they came to describe them, they shewed how little they understood what they meant by them, by disagreeing as much from one another, as from the truth they agreed in opposing: for they deliver their hypotheses as darkly as their processes; and 'tis almost as impossible for any sober man to find their meaning, as 'tis for them to find their elixir. And indeed nothing has spread their

philosophy, but their great brags and undertakings; notwithstanding all which I scarce know anything they have performed worth wondering at, save that they have been able to draw Philoponus to their party, and to engage him to the defence of an untelligible hypothesis, who knowes so well as he does, that principles ought to be like diamonds, as well very clear as perfectly solid.

CARNEADES (*Addressing himself to Eleutherius*): I hoped for a demonstration, but I perceive Themistius hopes to put me off with an harangue, wherein he cannot have given me a greater opinion of his parts, than he has given me distrust for his hypothesis, since for it even a man of such learning can bring no better arguments. The rhetorical part of his discourse, though it make not the least part of it, I shall say nothing to, designing to examine only the argumentative part, and leaving it to Philoponus to answer those passages wherein either Paracelsus or chymists are concerned: I shall observe to you, that in what he has said besides, he makes it his business to do these two things. The one to propose and make out an experiment to demonstrate the common opinion about the four elements; and the other, to insinuate divers things which he thinks may repair the weakness of his argument, from experience, and upon other accounts bring some credit to the otherwise defenceless doctrine he maintains.

To begin then with his experiment of the burning wood, it seems to me to be obnoxious to not a few considerable exceptions.

And first, if I would now deal rigidly with my adversary, I might here make a great question of the very way of probation which he and others employ, without the least scruple, to evince that the bodies commonly called mixt are made up of earth, air, water, and fire, which they are pleased also to call elements; namely that upon the supposed analysis made by the fire, of the former sort of concretes, there are wont to emerge bodies resembling those which they take for the elements. For not to anticipate here what I foresee I shall have occasion to insist on, when I come to discourse with Philoponus concerning the right that fire has to pass for the proper and universal instrument of analysing mixt bodies, not to anticipate that, I say, if I were disposed to wrangle, I might alledge, that by Themistius his experiment it would appear rather that those he calls elements are made of those he calls mixt bodies, than mixt bodies of the elements. For in Themistius's analysed wood, and in other bodies dissipated and altered by the fire, it appears, and he confesses, that which he takes for elementary fire

and water are made out of the concrete; but it appears not that the concrete was made up of fire and water. Nor has either he, or any man, for ought I know, of his persuasion, yet proved that nothing can be obtained from a body by the fire that was not pre-existent in it.

(*At this unexpected objection, not only Themistius, but the rest of the company appear not a little surprised.*)

PHILOPONUS (*Addressing himself to Carneades*): You cannot sure propose this difficulty, not to call it cavil, otherwise than as an exercise of wit, and not as laying any weight upon it. For how can that be separated from a thing that was not existent in it? When, for instance, a refiner mingles gold and lead, and exposing this mixture upon a cuppel to the violence of the fire, thereby separates it into pure and refulgent gold and lead (which driven off together with the dross of the gold is thence called *lythargyrium auri*), can any man doubt that sees these two so differing substances separated from the mass, that they were existent in it before it was committed to the fire?

CARNEADES: I should allow your argument to prove something, if, as men see the refiners commonly take beforehand both lead and gold to make the mass you speak of, so we did see nature pull down a parcel of the element of fire, that is fancied to be placed I know not how many thousand leagues off, continguous to the orb of the moon, and to blend it with a quantity of each of the three other elements, to compose every mixt body, upon whose resolution the fire presents us with fire, and earth, and the rest. And let me add, Philoponus, that to make your reasoning cogent, it must be first proved, that the fire does only take the elementary ingredients asunder, without otherwise altering them. For else 'tis obvious, that bodies may afford substances which where not preexistent in them; as flesh too long kept produces maggots, and old cheese mites, which I suppose you will not affirm to be ingredients of those bodies. Now that fire does not alwayes barely separate the elementary parts, but sometimes at least alter also the ingredients of bodies, if I did not expect ere long a better occasion to prove it, I might make probable out of your very instance, wherein there is nothing elementary separated by the great violence of the refiner's fire: the gold and lead which are the two ingredients separated upon the analysis being confessedly yet perfectly mixt bodies, and the litharge being lead indeed, but such lead as is differing in consistence and other qualities from what it was before. To which I must add that I have sometimes seen, and so questionless have you much oftener,

some parcels of glasse adhering to the test or cuppel, and this glass, though emergent as well as the gold or litharge upon your analysis, you will not I hope allow to have been a third ingredient of the mass out of which the fire produced it.

ELEUTHEREUS (*Addressing himself to Carneades*): You made at least half a promise, when you first proposed this objection, that you would not (now at least) insist on it, nor indeed does it seem to be of absolute necessity to your cause that you should. For though you should grant that there are elements, it would not follow that there must be precisely four. And therefore I hope you will proceed to acquaint us with your other and more considerable objections against Themistius's opinion, especially since there is a great a disproportion in bulke betwixt the earth, water, and air, on the one part, and those little parcels of resembling substances that the fire separates from concretes on the other part, that I can scarce think that you are serious, when to lose no advantage against your adversary, you seem to deny it to be rational to conclude these great simple bodies to be the elements, and not the products of compounded ones.

CARNEADES: What you alledge of the vastness of the earth and water, has long since made me willing to allow them to be the greatest and chief masses of matter to be met with here below: but I think I could shew you, if you would give me leave, that this will prove only that the elements, as you call them, are the chief bodies that make up the neighbouring part of the world, but not that they are such ingredients as every mixt body must consist of. But since you challenge me of something of a promise, though it be not an entire one, yet I shall willingly performe it. And indeed I intended not, when I first mentioned this objection, to insist on it at present against Themistius (as I plainly intimated in my way of proposing it), being only desirous to let you see, that though I discerned my advantages, yet I was willing to forego some of them rather than appear a rigid adversary of a cause so weak, that it may with safety be favourably dealt with. But I must here profess, and desire you to take notice of it, that though I pass on to another argument, it is not because I think this first invalid. For you will find in the progress of our dispute, that I had some reason to question the very way of probation imployed both by peripatetics and chymists, to evince the being and number of the elements. For that there are such, and that they are wont to be separated by the analysis made by fire, is indeed taken for granted by both parties, but has not

(for ought I know) been so much as plausibly attempted to be proved by either. Hoping then that when we come to that part of our debate, wherein considerations relating to this matter are to be treated of, you will remember what I have now said, and that I do rather for a while suppose than absolutely grant the truth of what I have questioned, I will proceed to another objection.

I consider then, in the next place, that there are divers bodies out of which Themistius will not prove in haste that there can be so many elements as four extracted by the fire. And I should perchance trouble him if I should ask him what peripatetic can shew us (I say not, all the four elements, for that would be too rigid a question, but) any one of them extracted out of gold by any degree of fire whatsoever. Nor is gold the only bodie in nature that would puzzle an Aristotelian, (that is no more) to analyse by the fire into elementary bodies, since, for ought I have yet observed, both silver and calcined Venetian talc, and some other concretes, not necessary here to be named, are so fixed, that to reduce any of them into four heterogeneous substances has hitherto proved a task much too hard, not only for the disciples of Aristotle, but those of Vulcan, at least, whilst the latter have employed only fire to make the analysis.

The next argument that I shall urge against Themistius's opinion shall be this, That as there are divers bodies whose analysis by fire cannot reduce them into so many heterogeneous substances or ingredients as four, so there are others which may be reduced into more, as the blood (and divers other parts) of men and other animals, which yield when analysed five distinct substances, phlegme, spirit, oile, salt, and earth, as experience has shewn us in distilling man's blood, hartshorns, and divers other bodies that belonging to the animal-kingdom abound with not uneasily sequestrable salt.

REPRINTED ARTICLE

PYRETHRUM INSECTICIDES*

By W. E. Edmonton

THE USE of pyrethrum flowers as a base for insecticides has increased with leaps and bounds, and our knowledge of their active principles is becoming more and advanced, but there is still much to be learned. The pioneer work was done by two Swiss chemists, but since then chemists of England, France, America and Japan have added to the fund of knowledge on this subject. Gnadinger and Corl [1] have continued their researches on the pyrethrin content of the flowers, using a copper reduction method for estimating the pyrethrins. The method is based on the fact that pyrethrolone will precipitate the copper from Fehling's solution, and the copper oxide so formed is dissolved in a phosphomolybdic solution. This gives a blue solution which is compared colorimetrically with solutions of a known glucose content that have been treated in precisely the same way. They also isolated the pyrethrins from the flowers and biologically compared solutions of these pyrethrins with solutions of flowers of a known pyrethrin content. As their method only determines the total combined pyrethrins, the pyrethrins were determined separately by Tattersfield's method. The biological tests were carried out on flies, specially bred, and the results showed that solutions of the pyrethrins agree very closely with solutions prepared from flowers containing a corresponding amount of pyrethrins. In comparing Pyrethrin I against Pyrethrin II it was observed that Pyrethrin II was 80 per cent. as toxic to flies as Pyrethrin I. This did not agree with the results of Tattersfield, Hobson and Gimingham,[2] as these authors found by testing solutions of pyrethrins on *Aphis rumicis* that Pyrethrin I was ten times as toxic as Pyrethrin II.

Gnadinger and Corl suggest that this difference may be due to the fact that Tattersfield and his co-workers used synthetic pyrethrin, whereas in their case they used pyrethrins prepared by repeated crystallization. H. Tatu [3] in some work on pyrethrum extracts adopted Gnadinger and Corl's method for estimating the pyrethrins, but his results did not have the accuracy which is indicated by the authors.

*Reprinted from *The Pharm. Jour. and Pharm.*, London, England.

He came to the conclusion that the cause of the inaccuracy was in the difficulty of making colorimetric comparisons, and therefore made a modification in the method, namely, to estimate the copper oxide volumetrically. This, however, was no improvement, and the author suggests that some of the trouble lies in the phenomenon that has already been proved in the case of sugars and is known as auto-reduction. Taking all things into consideration, he considers that the method is purely empirical and much too tedious to be of any use commercially.

Closed or Open Flowers

For some considerable time the generally accepted opinion was that closed pyrethrum flowers were more toxic than open ones, but evidence has proved that this is not the the case. In a paper published by the U. S. A. Department of Agriculture [4] it is shown that although open flowers as a whole are better than closed ones, it is possible to obtain inferior open flowers. The achenes of the flowers are proved to contain a higher percentage of active principle than any other part of the flower, and unless the flowers are harvested at the right time, and care taken in the drying to prevent the loss of achenes, it is possible to lose a considerable amount of the most toxic parts of the flowers. The active principle of the flowers was also determined by the methods of Staudinger, Tattersfield and Gnadinger, but the operators did not get very concordant results. From the results shown it is very evident that the different methods require a certain amount of experience in order to obtain accurate results, as in some cases the difference between the two methods varied as much as 100 per cent. Martin and Tattersfield,[5] however, were able to get results that agreed when using either of the last two methods mentioned, and in most cases the difference was less than 5 per cent. These authors also carried the analysis of pyrethrum flowers one step farther, and by a new method they show that it is possible to determine the pyrethrin content of a single flower-head. The method depends on a partial reduction of a standard alkaline ferrocyanide solution by means of the ketone group pyrethrolone fraction of the pyrethrin molecule. The degree of reduction is determined by the amount of ferrocyanide present before and after the reaction. By this test they were able to show that the pyrethrin content of the flower-head increases up to the stage when all the disc florets are open, and then the pyrethrin content commences to fall. The fall appears to commence just at the period when the flowers begin to turn yellow and are discolored.

Biological Tests

Richardson [6] in some work on pyrethrum used Tattersfield's method for the determination of the pyrethrin in the flowers, and found that it gave results which agreed with biological tests on houseflies. In flowers that had been artificially deteriorated both the insecticidal power and pyrethrin I content were lowered to a corresponding degree. It is suggested that the low pyrethrin content is due to exposure of the pyrethrins to heat or air when resinous bodies are formed which are insoluble in petrol, and are thus not extracted in the preliminary extraction with petrol. Hartzell and Wilcoxon [7] also carried out some experiments comparing the biological activity with the pyrethrin content, but they used *Aphis rumicis* for their biological tests. Their results, however, agreed with those of other workers, and it seems very evident that pyrethrin content is a true index of the toxicity of pyrethrum flowers. They also show that a decrease in pyrethrins can be produced by the action of heat, sunlight, ultra violet light and natural ageing, and in all cases there is a corresponding loss in toxicity. In some experiments with extracts of pyrethrum they were able to show that there is an axial gradient in toxicity to pyrethrum when applied to caterpillars, the caudal region being the most sensitive. When 1-50 cc. was injected into the last abdominal segment of a caterpillar it produced toxic symptoms almost immediately. They also showed that if an insect has received a dose insufficient to kill, when exposed to a higher temperature the process of recovery is accelerated, but on the other hand, when a lethal dose has been given, an increase in temperature accelerates death.

During the last three years, the manufacture of liquid insecticides from pyrethrum flowers has received considerable attention, with the result that it is now possible to obtain preparations that will remain stable for a considerable length of time. Concentrated extracts are manufactured which can be mixed with industrial spirit, isopropyl alcohol and kerosene to form insecticides for use against flies, wasps, bugs, cockroaches, beetles, mosquitoes, and other household pests. Kerosene is the usual medium for these household insecticides, mainly due to its cheapness and low flashpoint, but it has one great disadvantage, namely the unpleasant odor. This drawback, however, can easily be overcome by the use of perfumes and the careful selection of the kerosene. The most suitable perfume is one that volatilizes at approximately the same rate as the kerosene. The efficacy of these in-

secticides depends largely on the amount of active material present, but the method of application is also of importance. The proprietary fly sprays on the market contain varying amounts of active material, but it is generally recognized that an efficient spray should contain 1 part of total pyrethrins in 1000. As pyrethrum flowers contain varying amounts of pyrethrins it is necessary to know the pyrethrin content of the flowers in order that a standard insecticide can be prepared. As the pyrethrins become inactive with the slightest change in their chemical structure, great care should be taken in storage, and solutions of the flowers should not be exposed to light or air more than necessary.

In the control of household pests an important feature is to be able to apply the insecticide in the form of a very fine mist, thus impregnating the whole atmosphere with a suspension of minute particles of poison which penetrate into every nook and crevice. This can be achieved by means of an atomizer, of which various types are now manufactured and can be obtained at reasonable prices. In selecting the sprayer it is important to choose one that will give a very fine mist, as not only is it more economical but it also limits the amount of oily matter scattered about the room.

Determination of Pyrethrin in Kerosene Extracts

Although there are suitable methods for determining the pyrethrins in flowers these methods are not applicable for kerosene extracts, but R. C. Vollmar [8] has devised a method which can be used for determining the Pyrethrin I in kerosene extracts of pyrethrum containing small amounts of pyrethrin. A measured amount of the fly spray or extract depending on the amount of pyrethrin present is refluxed with several portions of $N/1$ alcoholic soda solution, the alcoholic soda being separated from the kerosene and collected in a separate flask. The mixed alcoholic solutions are acidified and then steam distilled. The distillate is then shaken out with petrol as in Tattersfield's method, and the monocarboxylic acid titrated with $N/50$ NaOH.

The use of pyrethrum in the control of insect pests is a matter of great importance to agriculture, and in preparing an insecticide great attention must be paid to the instability of the pyrethrins. British manufacturers, by means of considerable research, have forged well ahead in the production of stable preparations, and considerable thought has also been given to the possibility of damage to foliage and plant tissues. It is of interest to note that in experiments carried out

at the Long Ashton Research Station [9] against the raspberry and loganberry beetle, two British firms supplied the materials for the trials, and the results were very encouraging. Pyrethrum washes have also been used with much success against aphis, capsid bugs, willow beetle, cabbage fly, turnip beetle, apple blossom weevil, thrips, ants, larvæ of vine moth, codling moth and lackey moth and sawfly larvæ.

While the use of aqueous emulsions would appear the most suitable for tender foliage another line of attack has been tried with success against the coffee bug in East Africa.[10] Although kerosene extracts have hitherto been considerd unsuitable for spraying on plants, experiments have proved that by using an atomizer sufficient can be applied to coffee bushes to effect control of the pest without damaging the bushes. A suitable extract can be made by extracting pyrethrum flowers with kerosene, but as this entails a certain amount of labor and loss of time, use is made of the standardized concentrated extracts already on the market. These concentrated extracts are of a definite strength, and can also be diluted to form a spray for cowsheds and stables or, with the addition of a little perfume, a household fly spray. It is very evident that insecticides containing pyrethrum as the toxic principle have come to stay, for not only are they exceedingly toxic to insect life, but they have the advantage of being absolutely harmless to human beings and warm-blooded animals.

Action on Intestinal Parasites

Intestinal parasites are also extremely sensitive to the action of the pyrethrins, but owing to the rapidity with which the pyrethrins are destroyed in the digestive juices, indifferent results have been obtained with pyrethrum preparations against them. Three French authors,[11] however, report the use of a special granulated preparation which has proved extremely effectively and yet absolutely harmless, even with quite young children. The success of the treatment depends on the gradual liberation of the pyrethrins at every level of the digestive tract from the stomach to the rectum. The elimination of the worms starts almost immediately and continues for about eight days, and the most important feature is that they are dead and not paralysed as when expelled by the means of santonin and purges. No preliminary starving is necessary, and neither is any assistance required to expel the worm such as purging and rectal washing.

Arachnid parasites, of which the itch insect is the most important, have also been controlled successfully by the means of pyrethrum preparations without the slightest form of irritation or toxic action to the patient. Almost every parasite to animal and plant life can be controlled by means of pyrethrum preparations, but the all-important feature is that these preparations can be used without the risk of poisoning that attend the use of almost every other insecticide.

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ANESTHETICS FOR OYSTERS—The strength and skill required for the proper "shucking" of oysters have created a serious labor problem. The industry cannot expand as it otherwise might until cheaper, quicker, and less wasteful shucking is possible.

Experimenters of the Bureau of Fisheries have found it possible to anesthetize an oyster, without subsequent damage to it as an oyster, or to its flavor on eating, so that its shell will gape wide open, making removal of the animal a simple matter. It is an even simpler process than that of steaming, which injures the commercial value of the product.

Anesthesia, in this case, is induced by immersion of the oyster in very dilute acid, which, if desired, can be a "food" acid such as citric, tartaric or lactic acid. Not only does the relaxation do no harm to the shuckled oysters, but the trace of acidity makes them keep better.—(*Industrial Bull.* A. D. Little, Inc.)

MEDICAL AND PHARMACEUTICAL NOTES

Glycero-Gelatine

Gelatin	200	grammes
Glycerin	400	millilitres
Sucrose	50	grammes
Citric Acid	20	grammes
Sodium Benzoate	2	grammes
Oil of Lemon	1	millilitre
Solution of Carmine	10.4	millilitres
Triple Orange-flower Water	62.5	millilitres
Distilled Water	to 1000	grammes

Soak the gelatin in one and a half times its weight of distilled water until softened, add the glycerin and heat on a water-bath until the gelatin is dissolved and the mixture weighs 850 grammes; add the sucrose, citric acid and sodium benzoate previously dissolved in the triple orange-flower water, the oil of lemon, the solution of carmine and sufficient distilled water to produce the required weight. Strain through muslin and allow to cool.

The above is a formula proposed for the new *British Pharmaceutical Codex*.

Elixir of Ephedrine Hydrochloride

Ephedrine Hydrochloride	4.6 gm.
Distilled Water	83.3 cc.
Glycerin	200.0 cc.
Glycerin of Saffron	50.0 cc.
Spirit of Chloroform	50.0 cc.
Alcohol (90 per cent.)	125.0 cc.
Tincture of Lemon	50.0 cc.
Syrup	to 1000.0 cc.

Dissolve the Ephedrine hydrochloride in the distilled water and glycerin, adding the rest of the ingredients in the order noted.

The glycerin of saffron is present as a coloring agent—a not too fortunate choice because of the viability of that color. This formula was one proposed for the new *British Pharmaceutical Codex*.

X-RAYS SHOW PATTERN OF INSULIN CRYSTAL—Insulin, secretion of the islands of Langerhans in the pancreas which regulates the body's use of sugar, has the largest unit cell dimensions of any substance thus far recorded, X-ray investigations of the crystal form of insulin show. This evidence of the complex nature of insulin was brought out in a report by Prof. George L. Clark and Dr. Kenneth E. Corrigan, of the University of Illinois, to the National Academy of Sciences meeting at Ann Arbor.

Although it is barely ten years since insulin was first used to treat diabetes, efforts to determine its crystalline structure by means of X-rays have been going on for over two years. Prof. Clark and associates have found that the crystal is monoclinic and that upon the basis of a molemular weight of 35,000 there are 24 molecules to the unit cell.—(*Science News.*)

LACK OF VITAMIN A MAY CAUSE KIDNEY STONES—Evidence that lack of vitamin A in the diet may be the cause of kidney stones has been reported by Drs. C. A. Elvehjem and V. F. Neu, of the University of Wisconsin. These investigators found that in birds the kidneys undergo definite, harmful changes when the birds are deprived of vitamin A.

Other investigators, Drs. T. B. Osborne and L. B. Mendel in this country, and Dr. Robert McCarrison in England, observed a similar relation between kidney stones and lack of vitamin A in laboratory animals. Recalling that kidney stones are particularly prevalent among peoples of the Far East, Dr. McCarrison fed animals on diets made up of foods common in India. More than one-fifth of the animals developed kidney stones. When vitamin A was added to their East Indian diet, the animals did not have kidney stones.—(*Science News.*)

THE TOXIC EFFECTS OF CINCHOPHEN—T. G. Reah (*Lancet*, 1932, 5688, 504) reviews a number of cases of cinchophen poisoning. From his account it appears that the manifestations of poisoning may be numerous and include cutaneous rashes with or without œdema;

palpitation, giddiness, collapse, and cyanosis which may follow even one dose of the drug; nausea and vomiting; jaundice; transient albuminuria; exacerbation of the joint condition. In 35 cases jaundice followed the ingestion of cinchophen, and of these 17 recovered and 18 died. The appearance of toxic symptoms did not seem to depend on the amount of the drug taken, the milder symptoms having followed a single dose of 7½ grains. The smallest amount which resulted in death was 60 grains, taken over a period of two days, but fifteen weeks elapsed before the appearance of any toxic manifestations. Reah advises the cessation of treatment immediately toxic phenomena are shown, and in the more severe cases glucose in large amounts may be given by the mouth or intravenously. Calcium salts, either in the form of the gluconate or chloride (5 per cent.) may also be administered.

Although a number of fatalities have been observed, Reah considers that the drug has proved to be of undoubted value in certain cases of gout which have resisted all other forms of treatment. In those cases of gout where the attacks are infrequent, where the process is not severe, or where colchicum or other remedies alleviate the symptoms, it probably should not be used. In the severe cases where other treatments have been of no avail cinchophen, he considers, may be used provided that the danger is recognised and adequate caution is exercised. The patient should be tested with a small initial dose. If there is no evidence of idosyncrasy the drug should be given in the manner advised by Graham, that is, ten grains three times daily for three days a week, and alkalis may be coincidently administered.—(*Phar. Jour.*, London, England.)

CORRESPONDENCE

FRANCIS ASHLEY FAUGHT, M. D.
5006 Spruce Street, Philadelphia. Pa.

November 26, 1932.

THE FAUGHT TEST FOR ACETONE

Ivor Griffith, Editor,
American Journal of Pharmacy,
43d and Kingsessing Ave., Philadelphia, Pa.

My Dear Sir:

Some time ago I communicated with you regarding the ethylene-diamin-hydrate test for acetone, which received some study at the hands of Harry J. Schaeffer in 1926, the results of whose investigation appeared in the AMERICAN JOURNAL OF PHARMACY, 98:12 (December, 1926), 643.

In this article there appeared the following: "The summary of tests shows that for all practical purposes, the Faught Test establishes itself as being the most efficient and delicate. It is of extreme value when small quantities of acetone are to be detected, but due to commercial scarcity of ethylene-diamin-hydrate, and its extremely tedious process of preparation, it is of little single value."

I am pleased to report that due to the activities of the Eastman Kodak Company (Chemical Division), of Rochester, N. Y., this objection no longer exists. Therefore, since this objection to its use was raised in your Journal, I feel that it is only fair that attention of your readers should be called to the following:

The Eastman Kodak Company quotes the following prices as of May, 1932:

100 grams of ethylene-diamin-hydrate 95-100%	$3.45
100 grams of ethylene-diamin-hydrate 65-70%	2.05

Larger quantities are priced at proportional rates.

It has been found practical to use the weaker concentration in 5% solution, since it has been called to our attention by the article of Schaeffer, above referred to, that "if acetone is present, only so much

of the ethylene-diamin-hydrate will enter into the reaction, and that the addition of an excess will not hasten the reaction."

Now as to cost: 100 grams at $2.05 equals 5 grams at a cost of 10¢; this diluted to 100 cc. would produce a 5% solution. The value of 1 cc. would be 0.1¢, and since the four drops necessary to perform one test approximates 2/10ths of 1 cc. the cost of each test, so far as the ethylene-diamin-hydrate is concerned would be 0.04 of one cent, a purely negligible value.

This dilution if kept well stoppered in a colored bottle, is thoroughly stable, and should, in any laboratory performing a reasonable amount of tests, be completely used before it becomes worthless.

Yours very truly,

FRANCIS A. FAUGHT.

FAF:T

NEWS TEMS AND PERSONAL NOTES

MALLINCKRODT UTILIZES DRUG SURVEY RESULTS—In one of the most interesting studies presented at the St. Louis Drug Store Survey it was shown that of a total of 1,746 different ingredients prescribed in 1,563 prescriptions there occurred over 25 times only 80 chemicals, 81 Gallenicals and 70 manufacturers' specialties.

The Mallinckrodt Chemical Works, checking this list against their own sales records, found 84 prescription chemicals which can be considered as the fastest moving drug store items of this type.

In response to the increasing demand for prescription chemicals packed in the special Mallinckrodt 8-ounce shelf bottles, Mallinckrodt now offers every one of these 84 items in these popular bottles.

The outstanding features of these containers are the wide mouth and sloping shoulders which permit easy pouring and make every part of the bottle accessible to the spatula, as well as the screw-cap feature. The cap can be loosened or tightened by a half turn of the wrist and is lined with special fibre liners, forming an effective seal against dust and preventing cork contamination. Of course, the pleasing uniformity of display is an added attraction of these bottles.

A complete description and price list of these items has just been published.

MERCK & CO. ANNOUNCE NEW PROGRAM OF RESEARCH—Geo. W. Merck, President of Merck & Co., Inc., recently announced the appointment of Dr. Hans Molitor, of the University of Vienna, to the research staff of the company. Dr. Molitor will assume the direction of research work in pharmacology. In announcing the appointment, Mr. Merck stated:

"The addition of Dr. Hans Molitor, of Vienna, to the staff of Merck & Co., Inc., results from the decision of the management to adopt a policy of intensive research in pure and applied chemistry and allied subjects. To provide adequate facilities for this research work, Merck & Co., Inc., despite the depression, is constructing at Rahway, N. J., at the present time, a research laboratory to cost in excess of $200,000, which will house a staff of twenty-five research chemists.

Dr. Molitor will take over the supervision of the details of equipping and staffing the laboratory to be devoted to research in pharmacology.

Dr. Molitor comes to this country with a background of scientific accomplishment in the universities and hospitals of Europe. Born in 1895, in Austria, he took up his studies in the University of Vienna under the faculty of medicine in 1913, receiving his Doctor of Medicine Degree in 1921.

During the last year of the war, he did a considerable amount of outstanding bacteriological work, and following it he was an interne in the clinic of Professor Chvostek in Vienna. During the years 1919, 1920 and 1921 he was an interne in surgery and gynecology, and in the eye section of the hospital at Reichenberg.

From September, 1921, to September, 1923, he was an assistant in the Department of Pharmacology in the University of Vienna, later receiving a stipend from the Rockefeller Foundation, and studied in the University of Edinburgh under Prof. Barger, and worked in pharmacology under Prof. Cushny of that institution.

Following his studies in Scotland he also spent some time in Cambridge, London, and Utrecht, returning in 1924 to Vienna to the faculty of the university, where he continued his work in pharmacology until June, 1931, when he was made Extraordinary Professor of Pharmacology in that university.

Dr. Molitor has published a number of reports under his own name and jointly with his colleagues on various topics associated with pharmacological research work."

BOOK REVIEWS

THE PRACTICAL MEDICINE SERIES—GENERAL THERAPEUTICS—By Bernard Fantus, M. S., M. D., and Louis B. Kartoon, B. S., M. D.

This is one of a well-known series of books which have been published annually for several years. It gives a critical review of the literature on pharmacologic and therapeutic topics published during the year 1931. It is not a summary of all the new discoveries, or near-discoveries, during the past year but rather a discriminating survey of the therapeutic literature during the past year. Of especial interest during this time has been the increased knowledge of the endocrine hormones and of the chemistry and effects of the vitamines. This and many other topics which are being widely discussed today are well considered. The success of such a summary requires not only a wide acquaintance with the literature but a mastery of the subject involved, both of which qualifications are possessed to an eminent degree by the senior author.

H. C. WOOD.

CHEMISTRY OF THE OPIUM ALKALOIDS—By Lyndon F. Small, Consultant in Alkaloidal Chemistry, U. S. Public Health Service, University of Virginia. Supplement No. 103, Public Health Service, U. S. Treasury Department. For sale by Superintendent of Documents, Washington, D. C.

Opium yielded the first alkaloid discovered—morphine. Twenty other alkaloids were subsequently isolated from this drug. The chemistry of these alkaloids has received very much attention from the most outstanding chemists. The unraveling of the architecture of the structure of the molecules of these alkaloids has, for a long time, taxed the ingenuity and experimental resourcefulness of the chemist. A literature of over a thousand published investigations on the chemistry of these alkaloids, widely scattered in the journals of many lands, has accumulated. Dr. Small undertook to gather and classify this extensive material in one volume of 375 pages, and he has been eminently successful in the accomplishment of this task.

The book is divided into two parts. The first part deals with the alkaloids derived from isoquinoline. These constitute the minor alkaloids of opium, *e. g.,* Papaverine, Narceine, Narcotine, Laudanosine, etc. The second part deals with the alkaloids having phenanthrene as their parent, such as Morphine, Codeine and Thebaine. A separate chapter is devoted to each of the alkaloids. The name of the discoverer and date of discovery, and a description of the physical properties of the alkaloid forms the introductory part of each chapter. This is followed by discussion and elucidation of the chemistry and constitution of the alkaloid, profusely illustrated with structural formula. Each chapter also includes a description of all of the salts of the alkaloid, its ethers and esters, and other derivatives known to date. A complete bibliography, up to 1931, is found at the end of each chapter. An abstract of the literature from this date to January, 1932, is given in an appendix. The author believes that "every reaction and every compound described in the literature is mentioned in the book."

The author modestly claims that "the purpose of the book is, primarily, to make accessible what is known of the chemistry of these alkaloids." This alone would be a valuable and most welcome contribution to the chemistry of alkaloids, but the scope of this volume extends far beyond a mere collection of facts. The author has critically organized the observations and facts that have accumulated for over a century. He has done a great service to the organic chemist, and the science of chemistry and its followers owe him a debt of gratitude. No worker in organic chemistry, and especially the chemistry of alkaloids, can afford not to have this book on his reference shelf.

JOSEPH ROSIN.

HANDBOOK OF PHARMACOGNOSY—By A. Tschirch. 2d ed., issue 11, 101 pages, 11 illustrations. Publisher, B. Tauchnitz. Leipzig, 1932; paperbound, appr. $2.00.

In this new issue of the well-known monumental work, Professor Tschirch of Berne, Switzerland, and Professor E. O. von Lippmann of Halle, Germany, discuss the building stones of the history of pharmacognosy. The first chapter treats in a general way with the knowledge in prehistoric time and as recorded for primitive people.

In the subsequent 7 chapters detailed reference is made to the drugs used, according to early records, by the people of Egypt, Sumer (in the south of Babylon), the Semitic people: Babylonians, Hebrews, Syrians and Arabs, the Arish race—people of India and Persia. Finally, the people of China, Japan and of Greece.

References to recent publications testify to the thoroughness with which the revision is carried out. The striking photographs, depicting early records, are welcome additions. Various lists as those of plants and drugs (with native names), used by the Hebrews of the one, enumerating 398 identified drugs with the Chinese names, should prove very valuable for reference. The fact of identity should stimulate research in materia medica of those people, ancient and living.

Even one who is not historically inclined, will be greatly entertained and profited by the comprehensive treatment of the historical phase of crude drugs here presented.

Arno Viehoever.

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The Stradivarius violin was made of the same material as any other violin, but into it was built a skill and an experience which deserved and won an outstanding reputation.

The pharmaceutical products of the House of Wyeth contain the standard ingredients, but into them has been built a skill and an experience which have won for them an enviable reputation with the medical profession.

This reputation warrants the physician's specifying "Wyeth's" when he prescribes U.S.P. and N.F. formulae—particularly Wyeth's Standardized Tinctures, because they are made by percolation from selected drugs and are standardized by chemical and biological test according to the latest approved methods. The final product—the tincture—is then assayed to conform to U.S.P. or N.F. standards.

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